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| APPLICATION NO.              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/826,564                   | 04/16/2004  | Edward R. Engbrecht  | 5347-219            | 2107             |
| 20792                        | 7590        | 03/02/2006           | EXAMINER            |                  |
| MYERS BIGEL SIBLEY & SAJOVEC |             |                      | HO, TU TU V         |                  |
| PO BOX 37428                 |             |                      | ART UNIT            |                  |
| RALEIGH, NC 27627            |             |                      | PAPER NUMBER        |                  |
|                              |             |                      | 2818                |                  |

DATE MAILED: 03/02/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/826,564

Applicant(s)

ENGBRECHT ET AL.

Examiner

Tu-Tu Ho

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 20 December 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-11, 13 and 16-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-11, 13 and 16-21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_.

### **DETAILED ACTION**

1. The oath/declaration filed on 08/23/2004 is acceptable.
2. Applicant's Amendment filed 12/20/2005 has been reviewed and placed of record in the file.

#### ***Election/ Restriction***

3. Applicant's election without traverse of Species IIA, claims 1-10, 11, 13, and 16-21, in the reply filed on 12/20/2005 is acknowledged.

#### ***Claim Objections***

4. **Claims 7, 11, and 13** are objected to because of the following informalities:
  - 4.1. **Claim 7** should refer back to all limitations of a previous claim, claim 1. There is no reason to believe that Applicant is claiming in claim 7 another, second boron carbo-nitride layer in addition to **the** boron carbo-nitride layer of claim 1 and another, second boron source precursor in addition to **the** boron source precursor of claim 1, and would be so interpreted for examination purposes; accordingly, "a" should be replaced with "the" or "said". If Applicant is claiming in claim 7 another, second boron carbo-nitride layer in addition to the boron carbo-nitride layer of claim 1 and another, second boron source precursor in addition to the boron source precursor of claim 1, then claim 7 should be amended to clearly indicate such intention, such as "further comprises", "another", "second",...;

4.2. **Claim 11** should refer back to all limitations of a previous claim, claim 2. There is no reason to believe that Applicant is claiming in claim 11 another, second boron source precursor in addition to **the** boron source precursor of claim 2, and would be so interpreted for examination purposes; accordingly, “a” should be replaced with “the” or “said”. If Applicant is claiming in claim 11 another, second boron source precursor in addition to the boron source precursor of claim 2, then claim 11 should be amended to clearly indicate such intention, such as “further comprises”, “another”, “second”,...; and

4.3. **Claim 13** depends on a claim that has been canceled. Amend claim 13 so that it depends on a claim that has not been canceled and such that “the nitrogen source” has a proper, distinct antecedent basis. For examination purposes, dependency for claim 13 is claim 11, and “the nitrogen source” is interpreted to be “the boron source precursor is combined with a nitrogen source, wherein the nitrogen source”.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. **Claims 1, 3-6, and 10** are rejected under 35 U.S.C. 102(a) as being anticipated by Ekerdt et al., *Design, growth and Properties of Boron Carbonitride Insulating diffusion Barriers for Nanosized Electronic Devices* ([http://www.materialsworld.net/mwn/strasbourg\\_research/abstracts/Ekerdt\\_Duday\\_abstract.pdf](http://www.materialsworld.net/mwn/strasbourg_research/abstracts/Ekerdt_Duday_abstract.pdf), loaded 02/25/2006).

Referring to **claim 1**, Ekerdt et al. disclose a method of forming a boron carbo-nitride layer (BCN, first paragraph) comprising:

forming a boron carbo-nitride layer on a substrate (inherent) by chemical vapor deposition (CVD, second paragraph) using a boron source precursor (DMAB, third paragraph; DMAB is short for Dimethylamine borane complex  $[\text{NH}(\text{CH}_3)_2:\text{BH}_3]$ , as explained by the present invention, paragraph [0032], Example 1) comprising  $\text{NR}_3:\text{BX}_3$ , wherein X is selected from the group consisting of hydrogen and halide and wherein R is selected from the group consisting of hydrogen, alkyl, allyl, alkenyl, alkynyl alkylaryl, arylalkyl, phenyl, alkene and alkyne.

Although the reference is not dated, there is reason to believe that the reference is published before the invention thereof. If the reference is not published before 04/17/2003, the effective filing date of the present invention, Applicant just has to mention briefly in the next communication.

Referring to **claims 3 and 10**, Ekerdt et al. further disclose that the boron source precursor comprises a dimethylamineborane complex, as detailed above.

Referring to **claim 4**, Ekerdt et al. further disclose that wherein each R is the same (R=H).

Referring to **claim 5**, Ekerdt et al. further disclose that wherein each R is different (R=H, R=C, R=CH).

Referring to **claim 6**, Ekerdt et al. further disclose that wherein two R components are the same (R=H).

**6. Claims 1 and 4-6** are rejected under 35 U.S.C. 102(b) as being anticipated by Levy et al. (cited by Applicant on 08/23/2004, reference numbered 8).

Referring to **claim 1**, Levy discloses a method of forming a boron carbo-nitride layer (B-N-C-H, abstract; because Applicant has not clearly established and clearly defined any characteristics associated with the order of the components of the term with respect to the claimed boron carbo-nitride, it is the Examiner's position that a layer comprising boron, carbon, and nitride by the prior art formed by a similar process with a similar precursor as the claimed is properly termed a boron carbo-nitride layer. If applicant disagrees, Applicant is invited to supply a showing of unexpected result illustrating why one would properly term said prior art layer a boron carbo-nitride layer. Applicant is reminded upon such a submission, that the claims be commensurate in scope with the showing, i.e. claims composition, temperature, etc.) comprising:

forming a boron carbo-nitride layer on a substrate (inherent) by chemical vapor deposition (LPCVD, page 470) using a boron source precursor (TEAB, page 470; TEAB is short for triethylamine borane complex  $[\text{NC}_2\text{H}_5:\text{BH}_3]$ , as explained by Levy U.S. Patent 4,868,093, col. 5, lines 4-10) comprising  $\text{NR}_3\text{:BX}_3$ , wherein X is selected from the group consisting of hydrogen and halide and wherein R is selected from the group consisting of hydrogen, alkyl, allyl, alkenyl, alkynyl alkylaryl, arylalkyl, phenyl, alkene and alkyne.

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Referring to **claim 4**, Levy further discloses that wherein each R is the same (R=H).

Referring to **claim 5**, Levy further discloses that wherein each R is different (R=H, R=C, R=CH).

Referring to **claim 6**, Levy further discloses that wherein two R components are the same (R=H).

7. **Claims 1-2 and 4-6** are rejected under 35 U.S.C. 102(a) as being anticipated by Kosinova et al., *Chemical Composition of Boron Carbonitride Films Grown by Plasma-Enhanced Chemical Vapor Deposition from Trimethylamine borane*.

Referring to **claim 1**, Kosinova discloses a method of forming a boron carbo-nitride layer (Boron Carbonitride, title; BCN, page 367, col. 2) comprising:

forming a boron carbo-nitride layer on a substrate (Si substrate, page 367, col., paragraph 3) by chemical vapor deposition (PECVD, page 367) using a boron source precursor (TMAB; TMAB is short for trimethylamine borane complex  $[N(CH_3)_3 : BH_3]$ , page 366 (first page of the reference), col. 2, last full paragraph ) comprising  $NR_3 : BX_3$ , wherein X is selected from the group consisting of hydrogen and halide and wherein R is selected from the group consisting of hydrogen, alkyl, allyl, alkenyl, alkynyl alkylaryl, arylalkyl, phenyl, alkene and alkyne.

Referring to **claim 4**, Kosinova further discloses that wherein each R is the same (R=H or CH).

Referring to **claim 5**, Kosinova further discloses that wherein each R is different (R=H, R=C, R=CH).

Referring to **claim 6**, Kosinova further discloses that wherein two R components are the same (R=H or CH).

Referring to **claim 2**, Kosinova further discloses that the chemical vapor deposition is a thermal chemical vapor deposition (the substrate is maintained at a temperature, page 367, col. 1, paragraph 3, and the process is maintained at a certain temperature, disclosed throughout the reference, abstract and Fig. 1, for example) qualifying the chemical vapor deposition process as a thermal chemical vapor deposition).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. §103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**8. Claims 3, 7-11, 13, and 16-21** are rejected under 35 U.S.C. §103(a) as being unpatentable over Kosinova et al., *Chemical Composition of Boron Carbonitride Films Grown by Plasma-Enhanced Chemical Vapor Deposition from Trimethylamine borane*.

Kosinova discloses a method of forming a boron carbo-nitride layer substantially as claimed and as detailed above. Specifically, with respect to the limitation a microelectronic substrate of **claims 7 and 11**, Kosinova discloses a silicon substrate (as detailed above), therefore, it can not be said that Kosinova discloses exactly as claimed. However, it is known that a silicon substrate, at the time the invention was made, invariably used a semiconductor device, and as such it involves the movement of electrons, and as such, it is properly termed an



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electron moving substrate, or electron substrate for short, or could be termed a microelectronic substrate.

In reference to **claims 3 and 10**, Kosinova discloses TMAB, instead of DMAB, as detailed above, for the boron source precursor. However, from reviewing the specification of the present invention and the various references cited thus far, the examiner has not been able to find concrete documentation providing that one of the two boron source precursors, that of TMAB and DMAB, is superior to the other. Since that various boron source precursors eventually form a low dielectric constant dielectric material with minimized RC time delay, providing the various boron source precursors, that of TMAB and DMAB, would have been obvious to one of ordinary skill in the art at the time the invention was made.

With respect to the various claimed temperatures, thickness, and conditions, Kosinova teaches that initial compositions, nature of the gas, temperature, and other process conditions, play a key role in determining the final characteristics of said BCN layer (abstract), and since it has been generally accepted that experimenting process conditions and materials to obtain a working product is a skill possessed by a person of ordinary skill in the art, experimenting with process conditions and materials to obtain a working product would have been obvious to one of ordinary skill in the art at the time the invention was made.

With respect to claim that the nitrogen source is ammonia (**claim 13**), Kosinova disclose that a nitrogen source is ammonia (abstract).

### ***Conclusion***

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9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tu-Tu Ho whose telephone number is (571) 272-1778. The examiner can normally be reached on 6:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, DAVID NELMS can be reached on (571) 272-1787. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Tu-Tu Ho  
February 25, 2006